

# E-voting Experiences: A Case of Namibia and Estonia

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**Abstract:** Electronic voting is rapidly gaining momentum and offers more advantages than the paper-based voting system. The field of e-voting is an undiscovered sphere and its true extensity is mostly uncharted. Very few countries have successfully implemented e-voting and diminutive research has been conducted to investigate the factors that influence the successful implementation of e-voting. This paper documents a systematic review of various research studies that have recorded and reported on e-voting experiences in Namibia and Estonia. This study evaluated and analysed the two case studies and discovered factors affecting the successful implementation of e-voting. The factors include: ICT infrastructure, legal and institutional factors, security and trust, acceptance and adoption of ICT, political factors, voter education and planning. This study contributes to the body of knowledge by identifying key factors that affect the successful implementation of e-voting from two countries with successful e-voting experiences.

**Keywords:** e-voting, voting, i-voting, ICT.

## 1. Introduction

Several countries have started considering improving the traditional paper-based voting system by using Information Communication and Technology (ICT) [1], [2]. Societies world-wide rely on ICT for business, work and leisure time activities [3] and by using ICT, traditional electoral procedures can be simplified and reduce the cost of human resources and time [3]. Electronic voting (e-voting) is the use of electronic means or Information Technologies to cast votes, outside the restricted electoral boundaries [4, 5]. E-voting systems have the potential to improve traditional paper-based voting procedures by providing mobility, convenience and flexibility to the voter [6].

The field of e-voting is an undiscovered sphere, its true and genuine extensity is still uncharted [5, 6]. E-voting is at its infancy throughout the world, it is not in use in most parts of Africa including SA [3, 6]. No empirical research till this far has been done to investigate the factors and components that influence the successful implementation of e-voting. Very few countries have endeavoured to implement e-voting and only one country Estonia [7] has successfully implemented e-voting at a large scale. A vast number of countries has either piloted or implemented e-voting (fully or partially) but very few have been successful [8, 9]. Despite the numerous benefits and advantages provided by e-voting, the decision to build such a system in order to conduct elections over public networks is neither simple or straight forward. The reason being that a long list of multidisciplinary requirements must be fulfilled [10, 11]. Successful e-voting implementation depends on a collection of factors, which may be unique given the local context where it is implemented.

It is imperative to note that the implementation of e-voting may be very difficult if the different procedures and techniques that support successful e-voting implementation are not in place [8, 12]. Gefen, Rose, Warkentin and Pavlou [13] acclaims that to overcome failure

on IS development; one should understand the issues underlying on its implementation first. Consequently, to ensure the successful implementation of e-voting, a deeper understanding is necessary to help comprehend what must be carried out to achieve success and avoid failure. This incorporates the identification of a set of factors that may influence the successful implementation of e-voting in SA. This study aims to explore factors that are significant to the successful implementation of e-voting.

This paper is structured as follows: Section 2 presents the main objectives of this study, while Section 3 discusses the research methodology used when conducting the study. Section 4 presents the literature reviewed on factors affecting e-voting implementation. Section 5 presents the findings and then followed by a discussion of the common factors that influence e-voting implementation in Section 6. The final section concludes the paper.

## **2. Objectives**

The main objective of this study was to assess and evaluate e-voting experiences around the world, and identify key factors and elements that affect e-voting implementation. In order to achieve the above-mentioned objective, the following sub-objectives were identified:

1. Identify countries with successful e-voting experiences.
2. Assess and evaluate two successful e-voting experiences (case studies).
3. Identify factors and elements that influenced the successful implementation of e-voting experiences identified above.

## **3. Methodology**

The primary objective for this study was to investigate factors that may have influence in the successful implementation of e-voting in SA. This study is a case study of two cases: Estonia and Namibia. Estonia was the first country in the world to successfully implement e-voting on a national scale, while Namibia was the first country in Africa to successfully implement e-voting on a national scale. A systematic review methodology was used for this study. The method is a procedure for collection and critical analyses of multiple research studies or papers. This research relied heavily on existing theory and research in order to collect, evaluate and analyse the two case studies. The main keywords used during the searching were restricted to: e-voting, internet voting, Estonia, and Namibia. To capture as many relevant studies as possible, the electronic searches were performed using Google Scholar and other scientific journals and databases back to 2000. Articles and studies that were most related to the research theme were considered for this study. Titles, abstracts and conclusions of conference papers and documents were reviewed.

## **4. Literature**

Many other countries have made several attempts to replace the traditional paper-based voting system with modern voting technology [14]. Literature suggests that these improvements started as early as in 1892 with the introduction of the lever-arch machine [3], then the introduction of optical-scan machines [15] and punch card systems for voting [16]. The next evolution saw the introduction of Direct Recording Electronic (DREs), Telephone, Kiosk, Internet voting systems and lastly the mobile voting systems [5, 6]. Very few countries have endeavoured to implement e-voting and only one country Estonia [7] has implemented e-voting at a large scale. A vast number of countries has either piloted or implemented e-voting (fully or partially) but very few have been successful. Table 1 below lists some of countries who have implemented e-voting.

Table 1: E-voting systems implemented around the world

Country	Voting Population	Election type	Year introduced	No of elections in use	Problems
Estonia	9 000	All levels	2005	6	None
Geneva	185 526	All levels	2001	8	None
India	770m	State	2001	4	None
Spain	300 000	Municipal	2002	1	None
Brazil	140m	All levels	1996	4	None
Namibia	1.2m	National	2014	1	None
Belgium	3.2m	General & municipal	1994	1	Failed
Ireland	4.5m	State	2002	2	Failed
Australia	218 000	ACT federal	2001	1	None
Philippines	52m	State	2010	1	None
UK	1.5m	Local govt	2000	2	None
Canada	98 000	Municipal	2002	1	None

#### 4.1 Geneva's experience

It all started in 1982 when the parliament passed a new law on the exercise of political rights, which allowed the testing of new voting methods in cantonal or communal matters. Since then, Geneva has introduced i-voting in a controlled environment. Starting in 2001 the system went through several trials and then between 2003 and 2005 through eight official votes [16, 17]. Internet Voting implementation has been supported by almost two third of the Geneva population. The application was tested on a representative sample of Geneva citizens and they discovered that giving people time to know the Internet voting application increased public support. Internet voting has been offered and used in two official elections, in the first elections 43.6 percent of the votes were cast on Internet, and it has been growing from there [16]. It was also noted that an enormous number of voters over the age of sixty used Internet than the expected youth. This is a clear indication that the choice of voting methods is not linked to the age [8, 16, 17].

#### 4.2 Indian experience

India is the world's largest democracy with a community of 1.1 billion; India has a constituency of 770 million people and just like most African countries, most voters reside in poor rural areas. India faces various challenges such as poverty and illiteracy, which has the potential to contribute to low voter participation in election. The election process in India takes place over a month because of the large population that is eligible to vote. Consequently, India turned to technology to simplify the voting process. India's technology evolution started in 1998, when the country developed its own electronic voting machines (EVM) to cater for millions of voters [16, 18, 19]. The majority of voters in India used the e-voting system in the 2009 elections and the election authorities are adamant that the E-voting system they used is fully secure. The technology was able to solve a lot of problems associated with the traditional paper-based voting system. India has received numerous accolades for conducting free and fair elections on such a large scale.

However, before its adoption there were pilot schemes in five states to familiarise the voters with the technology, the voters supported and felt comfortable using the system for elections [18,19,20]. The current voting mechanism has many security problems, and it is very difficult to prove security aspects [9], [22], [23].

#### 4.3 Nigerian experience

Nigeria's democracy is the most populated and overcrowded democracy in Africa with a population of about 160 million. Independent National Electoral Commission (INEC) is the

body created by the constitution to organize all government elections in Nigeria. E-voting was endorsed for Nigeria's 2007 general elections, but Nigeria attempted to use electronic data capturing machines first to prepare the voter register for the 2007 elections [15, 24, 25]. Due to distrust for potential massive abuse of the system, the officials had to put the plans on hold. In addition, the huge cost of e-voting, also the high rate of illiteracy in the country, as well as the lack of political will to remedy all these, discouraged Nigeria from deploying full E-voting systems for the 2007 elections. In 2015, INEC implemented electronic voter authentication [24, 25, 26].

In this system the card reader, which is a portable electronic voter authentication device, is configured to read a voter card. The card reader was designed specifically for the accreditation process, authentication of eligible voters before voting. The card reader was designed and configured to read only the permanent voter cards issued by the INEC and can only work on election day. However, the electoral commission postponed the elections by six weeks, due to the poor distribution of permanent voter cards (only 34% delivered). Although the 2015 election exercise was declared the best in the history of the country, it was not without challenges. During the elections there were technical problems with the biometric card readers and the election were extended for a day due to delays. The technology was introduced to prevent voter fraud [25, 26, 27].

## 5. Results

This section presents the e-voting experiences from Namibia and Estonia. Estonia was the first country world-wide to successfully implement e-voting, while Namibia was the first African country to successfully implement e-voting.

### 5.1. Namibian Experience

Africa saw its first nation-wide use of e-voting during the Presidential elections in Namibia. The Electoral Commission of Namibia (ECN) responsible for organising and conducting election in Namibia, purchased 3,400 Electronic Voting Machines (EVMs) from India. These machines were developed and designed specifically for the electoral process in Namibia [28]. The EVMs were introduced by ECN in order to address some of the shortcomings of previous election system. Each EVM records a maximum of 3,840 votes. The EVMs have two components; the Control Unit (CU) and the Ballot Unit (BU) as shown in Figure 1 below.



Figure 1: Electronic voting machine: The Control Unit, Ballot Unit and the Tabulator

The EVMs have a controller that has its operating programme engraved permanently in a silicon at the time of manufacturing. No person including the manufacturer, can change the programme once the controller is manufactured [28, 29]. For voting purpose, the Presiding officer or a polling officer retains the CU during elections, while the BU is placed inside the voting compartment for the voters. Rather than issuing a ballot paper, the

Presiding officer in charge of the CU pushes the ballot button to enable the voter to cast their vote. The voter in return pushes a button on the BU against the candidate and symbol of their choice. After the last voter has voted, the Presiding officer pushes the “Close” button. Afterwards, the EVM will not acknowledge any vote. The BU is then disconnected from the CU and kept separately. The EVMs do not provide a paper trail of votes cast [29, 30, 31].

Switching from traditional voting methods to the use of EVMs is not an easy exercise. The switch requires careful planning, and an environment in which the country’s citizens are completely trusting of the technology and the electoral system itself. The International IDEA notes that it is essential that a strong trust of the electoral system exists, both at the socio-political level, operational and technical level [30, 31]. The organisation recommends that countries should be clear on their goals and the purpose for using EVMs, and that thoughtful efforts must be made to ensure timely implementation, training, transparency, and sustainability. The ECN conducted intensive trainings on the use and operation of the EVMs across all thirteen regions in 2013.

Mock elections were organised and implemented, where the ECN targeted small locations and tertiary institutions to ensure the smooth working thereof and make people accustomed to the new operation. Then the machines were used in by-elections to prepare for the roll-out on a national scale for the 2014 elections. The ECN also exhibited the machines at the Windhoek Show in 2012, providing members of the public an opportunity to view the machines. All these initiatives were done so to prepare all election stakeholders for the nation-wide use of EVMs [28, 29, 30, 31].

## 5.2. Estonian Experience

The National Electoral Committee in Estonia started the e-voting project in 2003. By March 2007 they had the world’s first national Internet election. In 2011 Estonia become the first country in the world to allow its citizens to cast their votes in the parliamentary elections using mobile phones [32, 33, 34]. Although the system is not entirely a m-voting system, here the mobile phone with the respective SIM card is used to identify and give a digital signature for authenticating the voter.



Figure 2: Internet voting client software

The mobile phone acts as a card and a card reader at the same time but the voter still needs a computer with an Internet connection for the voting process. The traditional paper-based voting is given priority and if the voter decides to go to a polling station during advance polls and cast a vote, the e-vote will be deleted. About 3.4 percent voters used remote e-voting and the Estonian officials said the i-voting system (Figure 2 above) used in

2007's elections proved secure despite worries about hacker attacks, identity fraud and vote count manipulation [33, 34, 35].

The elections were successful and the Estonians claim the system is the most secure way to authenticate digital signatures. Estonians are looking forward to the next elections as new improvements will be made to the current system [35, 36, 37, 38]. The Estonian experience in deploying Internet voting is discussed in detail in [32], how they have systematically addressed the legal and technical considerations required to make Internet voting a functioning voting platform, as well as the political and cultural framework that promoted this innovation. This system is further explained by [33], which includes the use of smart cards and electronic signatures. Also, the Estonians have recorded their Internet voting experience as the greatest experience with a high degree of trust such that plans are in place to introduce mobile phone voting [36, 37, 39].

## 6. Discussion

Both the Namibian and Estonian e-voting models can be considered a success on a number of levels.

The first step for Namibia was to identify the factors that could help and lead them to a successful implementation of e-voting. This included recognising the drawbacks of the paper-based voting system and also specifying the reasons for shifting to an e-voting system. The country went through introspection, looking at its current situation, environment including the citizens and developed a thorough e-voting plan. In order to win the trust of the citizens, the ECN conducted intensive trainings on the use and operation of the EVMs across all regions and also implemented mock elections. The transformation from traditional paper-based voting system to an e-voting system was implemented in a transparent manner, where members of the public were invited to participate in mock elections and during exhibitions around the country. This opportunity provided members of the public a chance to voice out their opinions about the e-voting system.

The success of Estonia is due to key elements that were present that made introducing remote Internet voting practical and that have enabled it to work well. These elements include: the level of internet penetration and e-readiness among citizens, a supportive political culture, a legal structure that addresses remote Internet voting, a digital identification system, modern infrastructure and government IT programs, as well as a partnership between public and private sectors. The operationalisation of laws that govern e-voting implementation played a vital role and they thoroughly addressed the legal and technical concerns required, as well as the political and cultural determinants that promoted this innovation. This success can also be contributed to the utilisation of different authentication methods; a reasonable level of citizen's acceptance of e-services; and a high level of trust in the government and in the e-voting experience.

The key factors identified for a successful implementation of e-voting from these countries include:

- ICT infrastructure,
- Legal and institutional factors,
- Security and trust,
- Acceptance and adoption of ICT,
- Political factors,
- Piloting,
- Community engagement and communication,
- Planning and preparation, as well as
- Voter education.

Prior to the adoption of any e-voting system, several issues and challenges that could affect the overall success of this system must be taken care of. These may include social, technical, political, legal and economic issues. Also, the adoption and use of an E-voting system should not be impulsive or instantaneous [40]. The transition should rather be paced through transparent phases from trials, pilots, followed by full implementation. Trials can include non-binding elections, and also elections at local government levels.

## 7. Conclusions

Successful implementation of e-voting in any given context is not only about the voting system itself and is not straightforward and simple as it seems. Projects encounter diverse problems whether in developed or developing countries. Many studies have focused on failed e-voting implementation, while very little focus on the factors leading to success. The main aim of this study was to assess and evaluate e-voting experiences around the world, and identify key factors and elements that affect e-voting implementation. Our findings suggest that there are many technical, social, economic, organisational, and political factors that impact on successful implementation of e-voting. A country's technological progression, ICT infrastructure, voters e-readiness status, security, trust and transparency play a highly crucial role in the proliferation of e-voting and e-government. The field of e-voting is moderately new and presents a variety of diverse research opportunities.

This study then recommends for future work the development of a framework for a successful implementation of e-voting in developing countries like South Africa. This will require a thorough investigation of both successful and failed e-voting experiences around the world. The study could also propose steps that could be followed for successful implementation of e-voting.

## References

- [1] M. Achieng & E. Ruhode, "The adoption and challenges of electronic voting technologies within the South African context", 2013. arXiv preprint arXiv:1312.2406.
- [2] B. Isong, N. Netshipise & G. Dzawo, "A New Approach for Protecting Elections Integrity in South Africa", *International Journal of Computer Applications*, 2013, 62(20).
- [3] D. O. Adewumi, E. A. Oluwatosin, M. A. Bashorun & O. T. Arulogun, "Framework for Multilingual Mobile E-Voting Service Infrastructure for Democratic Governance", 2011.
- [4] E. Eilu & R. Baguma, "Bridging the User Experience Gap in Mobile Phone Voting in Developing Countries", *Strengthening the Role of Information and Communication Technology in Development*, 2012, 134.
- [5] S. Thakur, O. O. Olugbara, R. Millham, H. W. Wesso & M. Sharif, "Transforming voting paradigm—the shift from inline through online to mobile voting", In *2014 IEEE 6th International Conference on Adaptive Science & Technology (ICAST)*, 2014 (pp. 1-7). IEEE.
- [6] U. Ekong & V. Ekong, "M-voting: a panacea for enhanced e-participation", *Asian Journal of Information Technology*, 2010, 9(2), 111-116.
- [7] S. Heiberg, P. Laud & J. Willemson, "The application of i-voting for estonian parliamentary elections of 2011", In *International Conference on E-Voting and Identity*, 2011 (pp. 208-223), Springer Berlin Heidelberg.
- [8] M. Chevallier, M. Warynski & A. Sandoz, "Success factors of Geneva's e-voting system", *Electronic Journal of e-Government*, 2006, 4(2), 55-62.
- [9] A. Das, "Usability of electronic voting system in India and innovatory approach", *International Journal of Applied Science and Engineering Research*, 2015, 4(5), 633-642.
- [10] S. A. Adeshina & A. Ojo, "Design imperatives for e-voting as a sociotechnical system", In *Electronics, Computer and Computation (ICECCO)*, 2014 (pp. 1-4), IEEE.
- [11] N. Boulus-Rødje & R. Laanggaardsvej, "Mapping the literature: Socio-cultural, organizational and technological dimensions of e-voting technologies". In *Electronic voting*, 2012 (pp. 227-241).
- [12] A. Prosser & R. Krimmer, "The dimensions of electronic voting technology, law, politics and society", *Electronic Voting in Europe Technology, Law, Politics and Society*, 2004, 21-28.
- [13] D. Gefen, G. M. Rose, M. Warkentin & P. A. Pavlou, "Cultural diversity and trust in IT adoption: A comparison of potential e-voters in the USA and South Africa", *Journal of Global Information Management*, 2005, 13(1), 54.

- [14] D. Mpabanga & G. Mokhawa, "Is e-voting a possibility for Botswana's 2014 general elections?", *Pula: Botswana Journal of African Studies*, 2015, 27(2), 362-375.
- [15] T. Adeyinka & G. Olasina, "Voters' Perception of the Adequacy and Suitability of e-Voting in the Nigeria Polity", *Handbook of Research on E-Government in Emerging Economies: Adoption, E-Participation, and Legal Frameworks*, 2012, pp 123.
- [16] M. Chevallier, Internet Voting, Turnout and Deliberation: a Study. *Electronic Journal of e-Government*, 2009, 7(1), pp.29-44.
- [17] J. Gerlach & U. Gasser, Three Case Studies from Switzerland: E-Voting. *Berkman Center Research Publication*, 2009, p.17.
- [18] S. Singh, Towards understanding the process of e-Government application design in South Africa, 2014.
- [19] S. Pallav, S. Dhanalakshmi & S. Aiswarya, Mobile Voting using Global System for Mobile Communication (GSM) Technology and Authentication using Fingerprinting Biometrics and Wireless Networks. 2012 (2248), pp.63-68.
- [20] S. F. Solehria & S. Jadoon, Cost Effective Online Voting System for Pakistan, 2011.
- [21] U. O. Ekong & C. K. Ayo, "The Prospects of M-Voting Implementation In Nigeria", *3GSM & Mobile Computing: An Emerging Growth Engine for National Development*, 2007, pp 172-179.
- [22] R. Goswami & D. Sen, "Case Study on 'Technology and Elections in the World's Largest Democracy'", 2011, Available at SSRN 1883354.
- [23] O. M. Olaniyi, D. O. Adewumi, E. A. Oluwatosin, O. T. Arulogun & M. A. Bashorun, "Framework for multilingual mobile e-voting service infrastructure for democratic governance", *African Journal of Computing and ICT (Journal of IEEE Nigeria Computer Section)*, 2011, 4(3), 23-32.
- [24] O. Olusola & R. Adesina, A Framework for Electronic Voting in Nigeria. *International Journal of Computer Applications*, 2015, 129(3), pp.12-16.
- [25] B. E. Asogwa, Electronic government as a paradigm shift for efficient public services: Opportunities and challenges for Nigerian government. *Library Hi Tech*, 2013, 31(1), pp.141-159.
- [26] A. Jaleel, Adoption of E-Voting System in Nigeria : A Conceptual Framework. *International Journal of Applied Information System*, 2013, 5(5), pp.8-14.
- [27] H. N. Ozuru, J. E. Chikwe & J. G. Amue, Nigerias 2011 general election and 2015 electronic voting (E-voting) system. *African Business and Development in a Changing Global Political Economy: Issues, Challenges and Opportunities*, 2012.
- [28] I. K. Mensah, Citizens' Readiness to Adopt and Use Electronic Voting System in Ghana. World Academy of Science, Engineering and Technology, *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, 2016, 10(3), pp.780-786.
- [29] G. O. Uzedhe, & J. O. Okhaifoh, "A technological framework for transparent e-voting solution in the Nigerian electoral system." *Nigerian Journal of Technology* 2016, 35.3: 627-636.
- [30] A. Idrisa & R. Yusofb, Adoption of E-voting System in Nigeria: A Prospect for Poverty Alleviation, 2015.
- [31] S. Thakur, System architecture for secure mobile internet voting, 2015.
- [32] Estonian, Estonian e-voting system. 2011, pp.1-2.
- [33] J. I. Esteve, B. Goldsmith & J. Turner, International Experience with E-Voting. *International Foundation for Electoral Systems*, 2012.
- [34] A. G. Tsahkna, E-voting: lessons from Estonia. *European View*, 2013, 12(1), pp.59-66.
- [35] T. Kalvet, Innovation: a factor explaining e-government success in Estonia. *Electronic Government, an International Journal*, 2012, 9(2), pp.142-157.
- [36] A. H. Trechsel, Internet Voting in Estonia, 2011.
- [37] Ü. Madise & P. Vinkel, Internet voting in Estonia: from constitutional debate to evaluation of experience over six elections. In *Regulating eTechnologies in the European Union*. Springer, 2014, pp. 53-72.
- [38] S. Heiberg, P. Laud & J. Willemson, "The application of i-voting for estonian parliamentary elections of 2011", In *International Conference on E-Voting and Identity*, 2011 (pp. 208-223), Springer Berlin Heidelberg.
- [39] R. M. Alvarez, Voting: What Has Changed, What Hasn't, & Why: Research Bibliography, 2013.
- [40] S. Thakur & S. Singh, "A Study of Some e-Government Activities in South Africa", *African Journal of Computing and ICT*, 2013, 6(2), pp.41-54.